

When a half isn't enough!

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Teachers are constantly striving to teach for understanding of key mathematical ideas and teaching for depth and conceptual understanding is now being seen as an important part of successful mathematics teaching. However, we know that many students still have many mis-conceptions and shallow procedural knowledge of ideas such as fractions and decimals and percentages in secondary schooling.

How then might we teach for deeper understanding of these “big ideas” and how are the foundations of such understandings appropriately laid in the early years of schooling? Obviously, drilling children in procedures and rules at an early age is not the answer.

What might the understandings be that young children already have which we can build on in the K-2 years and what be might appropriate learning experiences and teacher interventions? This paper has been written to engage early childhood teachers in asking some questions about the mathematical ideas which underpin understanding of fractions and reflecting on their current practices.

Traditionally fractions have not been part of any early childhood curriculum; ideas of fractions were dealt with in the upper primary or early secondary curriculum. Why might we consider them to be part of the mathematical experience of young children?

Young children know about halves in an intuitive and everyday sense- they often describe themselves using phrases such as “I’m four and a half” and describe any item which has two pieces as being “in half”. This is usually a response to hearing adult conversation using such terms. Parents might say for example “I’ll cut your sandwich in half” or “it’s half full”. When children are introduced to informal measurement at school they will often refer to anything which is “left over” or not a whole unit, as “half”.

Is half enough? Should parents and early childhood teachers present other models of cutting and partitioning? Do children then come to see half as more important or different to other fractions, and does this make later understanding more difficult?

Researchers point to an over emphasis focus on half and quarters as a reason for many children’s difficulties in understanding fractions (Newstead and Murray (1998)).

The types of manipulatives used to introduce fractions may also lead to difficulties e.g. many materials are pre- partitioned or involve “Count and colour” (e.g. shade $\frac{1}{12}$ of this rectangle (which is pre-partitioned)) activities which do not lead to real understanding. In preference students should be engaged in folding, cutting and dividing objects and materials to see partitioning relationships and should be encouraged to visualize for example $\frac{1}{2}$ on a number line.

What might some key underpinning ideas for understanding fractions be?

Single objects or groups can be divided into parts

A fraction can be used to represent part of a collection: eg. 4 out of 5 shots went in

There are numbers between consecutive whole numbers: eg. 1.5

You can share things into equal groups.

Fairness in sharing often requires division into equal parts.

When you divide things into groups, sometimes there are some left over and the interpretation of this remainder will depend on the situation being represented

(Tasmanian K-8 Mathematics Guidelines for Number)

These ideas underlie any later work with representing, manipulating and thinking about fractions and a focus on them will help build conceptual understanding about what mathematical ideas provide a foundation for fraction investigations.

What might this look like?

Many early childhood classes present number lines to children. These usually start at 1 and go up in whole numbers. Might we naturally introduce children to the idea that there are many numbers in between whole number by talking about, modeling and adding number (both sides of zero) to young children? Might this help children build a “big picture” of the number system and might lower secondary teachers not then have to ‘un-teach’ children about how our number system works, if children have come to them believing that 0 is the smallest number and that the only numbers in between other number are halves? My experience with young children tells me that if this is done in a meaningful and natural way they can deal with the ideas. The number line can be added to over the year with new “parts” of numbers.

If our teaching focuses on building connections for children- in this case connections between fractions and division, important mathematical links can be made. This avoids the problems of topics being presented as separate “bits” with no connections being built for students.

If we present children with challenges of cutting, breaking and folding things into equal groups they can build mental images for themselves and see relationships. This can be supported by explicit focus from the teacher about the language we use to describe the pieces and the processes being undertaken. One such activity I involved a class of six years olds in was sharing out packets of *Tiny Teddies* fairly in groups of 4. As most small packs of *Tiny Teddies* have 13 in them this created some dilemmas about what to do with the left overs! It revealed some fascinating solutions, including one group of boys who decided to record their answers and requested some help in writing a half and explored the idea using different numbers of teddies.

We would of course, also continue to develop childrens’ real-life fraction knowledge by talking about events involving fractions e.g. “it’s $\frac{1}{2}$ time in the football” , “The ball went in the

goal 5 out of 6 times”, “we will cut the pizza into 5 equal bits” etc Parents can be encouraged to do the same.

Summary

There are many early experiences of fractions which can be built into an early childhood setting in natural and meaningful contexts and play situations. It is our role as teachers to help build important foundational ideas which underpin later more symbolic work with fractions. Knowing the mathematical ideas which underpin fractions, decimals etc is vital for teacher planning and for building deep understanding.

Some questions...

What activities could you share through the Virtual Conference to help others explore important ideas about fractions with young children?

How much symbolic language do children need to be exposed to?

What materials have you used which build understanding of fractions?

What can we do to build conceptual understanding of fractions for all students?

What aspects of current practice create difficulties for students when they meet ideas about fractions?

What research can inform our thinking about fractions for young children?

Is half enough?

References

Newstead and Murray (1998) summed up the factors that contribute to the poor understanding of fractions as follows:

- The initial presentation of fractions to children – both the way and the sequence in which the content is presented to them. For example, the use of pre-partitioned manipulatives and are restriction to halves and quarters only.
- A lack of opportunity in the class to resolve and monitor misconceptions (sometimes based on incorrect intuitions) that children might have.
- The tendency of children to apply their whole-number conceptual framework to fractions, interpreting a fraction as two whole numbers.

(available at <http://www.wcape.school.za/malati/Files/Fractions993.pdf>)

Tasmanian K-8 Mathematics Guidelines

(available at <http://www.discover.tased.edu.au/mathematics/k-8%20number.pdf>)

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